

# Chapter 2

## Literature review: Software customization in the information systems literature

### 2.1 Introduction

Companies increasingly need to understand their customers' wants and needs in order to strengthen their competitive position. Thus, in recent years, companies have started not only to discover customer needs by means of market research but also to integrate customers into the innovation process (Prahalad and Ramaswamy 2000; Von Hippel 2005). Concurrently, since the late 1970s, the co-creation of value has become a field of intense research in marketing and service science. Researchers have analyzed many different aspects of co-creation, for example, productivity gains through customer self-service (Czepiel 1990; Kelley et al. 1990), customer satisfaction, quality, employee performance and emotional responses (Bendapudi and Leone 2003), and the opportunity to differentiate products and services (Song and Adams 1993).

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<sup>1</sup>Parts of the results reported in this chapter were presented at the IFIP 8.2 Workshop, 2012 in Tampa, FL, USA (Bertram et al. 2012)

Thereby, customization has emerged as a concept to provide customers with tailor-made products and services.

With respect to customization, researchers have further concluded that customers should not be recognized as passive receivers but should be seen as active and knowledgeable participants in common innovation or co-creation processes (Nambisan 2002). For example, (Firat et al. 1995) introduced the concept of customerization, which enables consumers to serve as co-producers of the product and service offering. Relatedly, (Ghosh et al. 2006), who investigated the role of control in complex product customization, stated that the success of customization is a function of the customer's knowledge. Thus, co-creation researchers assume an outside-in perspective of customization in that they focus on the integration of external resources into the innovation process.

Another stream of research pertaining to the concept of customization stems from economics and marketing. Here, researchers obtain an inside-out perspective in that they refer to customization as a way to tailor and deliver products and services according to customers' needs (Franke et al. 2009). They further highlight the role of mass customization, which enables customer-specific production with near mass production efficiency and the realization of economies of scale (Kotler 1989; Tseng and Jiao 2001).

However, the majority of articles in both areas have been written in a business-to-consumer (B2C) context, with an emphasis on the role of consumers and individual customers (Etgar 2008; Franke and Schreier 2007). Within business-to-business (B2B) contexts, such as in the market for business software (e.g., enterprise resource planning (ERP) software), concepts such as mass customization are comparatively rare because (1) buyers' markets usually consist of only a few firms and (2) products are generally more complex than in B2C scenarios (Ghosh et al. 2006).

## 2.2 Concepts of customization

### 2.2.1 Existing concepts of customization

The term customization refers to the adaption of a product or service according to specific customer needs (see Kotler and Armstrong 2011). The general assumption in the literature is that products or services create higher benefits for customers because they deliver a closer fit to preferences (Franke et al. 2009). Based on this assumption, customization has become of strategic value for firms (Ghosh et al. 2006). It allows them to better match their offerings with customer needs, fosters customer satisfaction and loyalty, and potentially leads to increased delivery performance and profit (Fornell et al. 1996; Perdue and Summers 1991). In recent years, researchers and practitioners have paid increasing attention to the concepts of customization. The academic literature discusses concepts of customization under the term ‘mass customization’ and adopts the service perspective.

The term ‘mass customization’ was first coined by Davis (1989). It relates to the ability to provide customized products or services through flexible processes in high volume and at relatively low cost (Pine II 1993). The literature provides two general definitions for mass customization (Da Silveira et al. 2001). The broad, visionary concept describes mass customization as the ability to provide individually designed products and services to every customer through highly agile, flexible and integrated processes (Pine II 1993; Eastwood 1996). Thus, mass customization reaches customers, as in the mass-market economy, but provides individuality for them, as in the pre-industrial economies (Davis 1989). In the narrower sense, mass customization is defined as a system that uses information technology, flexible processes, and organizational structures to deliver a wide range of products and services that meet the specific needs of individual customers at near mass production costs (Hart 1995a; Kotha 1995; Ross 1996; Joneja and Lee 1998). Thus, the idea of mass customization involves all aspects of product or service – sales, development, production and delivery – from the customer’s

options to delivering the finished product or service (Kay 1993; Jiao et al. 1998).

According to Da Silveira et al. (2001); Fogliatto et al. (2012), the concept of mass customization is the natural evolution of many ideas that have emerged over the past three decades such as just-in-time, lean production and agile manufacturing. The foundation of mass customization is based on three ideas: (1) new manufacturing and information technologies enable firms to deliver higher product or service variety at lower cost; (2) there is an increasing need for product customization (Kotler 1989); and (3) shorter product life cycles and expanded industrial competition increase the need to focus production strategies on individual customers (Kotha 1995; Pine II 1993). In contrast to conventional flexible systems where customer needs are anticipated by delivering wide variety (Åhlström and Westbrook 1999), mass customization aims at delivering products and services that best translate to the actual choices of individual customers (Da Silveira et al. 2001). Thus, successful mass customization may bring major competitive strategy and performance enhancements by producing items that are more meaningful and valuable to the customer than competitors' offerings (Hart 1995a, 1996).

Determining the level of individualization for mass customized products has been a major debate (Da Silveira et al. 2001). Purists argue that MC must include all requirements made by an individual customer. More pragmatic approaches argue that mass customization must follow customer needs, independent of the number of options actually offered.

Based on empirical observation, Gilmore and Pine II (1997) identify four levels of customization: *collaborative customization*, in which the designer is in dialogue with the customer; *adaptive customization*, in which customers can alter standard products during their usage; *cosmetic customization*, in which standard products are packaged individually for each customer; and *transparent customization*, in which standard products are adapted to individual needs.

Lampel and Mintzberg (1996) suggest five customization strategies, describing different configurations of standardized or customized processes, commodity or unique products, and generic or personalized customer transactions.

Pine II (1993) distinguishes five stages of modular production: *customized services*, in which standard products are tailored by marketing before being delivered to the customer; *embedded customization*, in which standard products are altered by customers during usage; *point-of-delivery customization*, in which additional customization work is done at the point of sale; *providing quick response*, which refers to the quick delivery of products; and *modular production*, in which standard components can be configured in a variety of products and services.

In a similar vein, Spira (1993) develops a framework that includes four types of customization: (1) *customized packaging*, (2) *customized services*, (3) *additional custom work*, and (4) *modular assembly*.

Based on this foundation, Da Silveira et al. (2001) proposed a framework that describes mass customization along the value chain from pure customization (individually designed products) to pure standardization. *Design* refers to collaborative projects, manufacturing, and the delivery of products according to customer needs. *Fabrication* refers to the manufacturing of tailor-made products following a pre-defined design. *Assembly* refers to the arrangement of modular components into different customer-specific product configurations. Levels 5 and 4 add *additional custom work* and *additional services* to standard products, often at the point-of-delivery. *Package and distribution* targets market segments by providing similar products in, for instance, different boxes or sizes. In *usage*, customization occurs only after delivery, through products or services that can be adapted to different functions of situations. Finally, *standardization* refers to no customization at all. Table 2.1 summarizes Da Silveira et al.'s (2001) generic levels of mass customization.

Table 2.1: Generic levels of mass customization, based on Da Silveira et al. (2001)

Generic levels	Gilmore and Pine II (1997)	Lampel and Mintzberg (1996)	Pine II (1993)	Spira (1993)
Design	Collaborative; Transparent	Pure customization		
Fabrication Assembly		Tailored customization Customized standardization	Modular production	Assembling standard components into unique configurations
Additional custom work			Point of delivery customization	Performing additional custom work
Additional services			Customized services; Providing quick response	Providing additional services
Package and distribution Usage	Cosmetic Adaptive	Segmented Standardization	Embedded customization	Customized packaging
Standardization		Pure standardization		

Mass customization involves major aspects of operations and is not the best strategy for every company. According to Da Silveira et al. (2001) and Fogliatto et al. (2012), the success of a mass customization strategy depends on a series of six external and internal factors. Factors 1 and 2 are market related, and factors 3 - 6 are organization based.

1. *Customer demand for variety and customization must exist.* Mass customization success depends on increasing customer demand for innovative and customized products. (Pine II 1993; Hart 1996)
2. *Market conditions must be appropriate.* Mass customization success depends on the timing of its implementation and on whether the company is regarded as innovative and customer driven (Kotha 1995).
3. *Value chain should be ready.* As a value chain-based concept, mass customization depends on the willingness of suppliers, distributors, and retailers to attend to the system's demands (Feitzinger and Lee 1997).
4. *Technology must be available.* The implementation of advanced manufacturing technologies is fundamental for mass customization success (Lau 1995; Pine II 1993).
5. *Product should be customizable.* Modularity enables simpler and lower-cost manufacturing and is a core concept of mass customization. To produce in short life cycles, mass customization processes also need rapid product development and innovation capabilities (Kotha 1995, 1996).
6. *Knowledge must be shared.* As a dynamic strategy, mass customization depends on the ability to translate customer demands into new products and services. To achieve this, companies must pursue a culture that emphasizes knowledge creation and distribution across the value chain (Pine II 1993; Kotha 1995, 1996).

This section has provided a brief overview of customization concepts and discussion in the academic and practical literature. It introduced the im-

portance of customization by discussing the standardization versus individualization approaches. It has provided a definition of customization and general assumptions related to the understanding of mass customization as “customization with nearly production efficiency” (Tseng and Jiao 2001). Finally, I discussed the application of those concepts in the marketing, engineering and distribution literature. Based on this foundation, the following section will describe the research approach for my literature analysis in the information systems literature.

### **2.2.2 Software customization - a working definition**

In the early days of software development, when software and hardware were still closely bundled, the prices for these systems were extremely high because the market for software products was nonexistent. These systems were generally solely developed for individual companies according to their individual needs and requirements. In the late 1960s, computer manufacturers started to unbundle hardware and software systems as the result of an IBM initiative (Xu and Brinkkemper 2007). As a consequence, an independent software market for business-to-business (B2B) was built, and during the 1980s, a new class of software vendors started to pre-build and offer software for a range of business functions that could be delivered separately on a large scale.

However, to address each customer’s wants and needs, software was designed in such a way that each customer could adapt certain parts without changing the source code of the software (e.g., changing a desktop background, hiding navigation, etc.). Today, global enterprise software companies such as SAP, Oracle and Microsoft generally develop product software for wider, more anonymous (B2B) markets or industries. In these cases, requirements usually are not fully specified and are worked out in implementation projects with customers. Therefore, customization in information systems can be understood as a special type of co-creation of value and late product differentiation. The economic importance of these customization projects is



very high. For example, IBM's total revenue in 2007 was \$99B, with more than 50% (\$54B) resulting from consulting services including customization (Spohrer and Maglio 2008).

As discussed, the service of customizing complex product software has become a business itself. Crucial to the existence of this service industry is that complex business software requires changes at the source code level to be adapted to a user firm's needs. In addition, as shown by Ghosh et al. (2006) for mechanical industries, within software customization projects, project success is a function of the customer's knowledge. In particular, compared to mass customization in B2C scenarios, in which customers can choose colors or materials for the desired product (Reichwald and Piller 2003), due to the complexity of business software, the customer is usually unable to communicate its needs in an appropriate format. In addition, the professional customer's needs change due to environmental turbulence and market dynamics. Consequently, the process of adapting a software product to the professional customer's needs can drag on and demand several iterations. Thus, instead of communicating needs just once, as in the case of mass customization in B2C contexts, customizing complex product software requires an iterative approach and is dependent on the customer's knowledge as well as his ability to communicate needs.

Based on these preliminary insights, the following working definition of customization is provided for the literature analysis, recognizing that customization in general and mass customization in particular need to be distinguished more specifically in the context of software products:

*Customization is the process of configuring, parameterizing, or generally adapting an IS artifact to a customer's needs.*

## 2.3 Systematic literature analysis

According to authors such as Huff (2009) or Creswell (2009), one of the most well established methods for integrating research findings and assessing the cumulative knowledge within a domain is a qualitative literature review. This method allows researchers to analyze and evaluate both qualitative and quantitative literature within a research domain to draw conclusions about the state of a field. Because this method is well established, researchers have performed literature reviews and adapted this method to their needs and thereby developed several approaches to reviewing literature. For example, Huff (2009) differentiates between at least four types of literature reviews: (1) a survey to identify key issues and trends, (2) a critical review to identify arguments, standards and the potential for new contributions, (3) a systematic review to expose quantitative and qualitative results across several areas of interest and (4) a supportive review to generate new ideas and to resolve specific problems from existing literature. These four differ, for example, in purpose and in their primary and secondary sources of literature. Figure 2.1 illustrates the four types of literature analysis over time.

The research aim of this section is to draw a coherent picture of customization ideas and concepts in the current IS literature and thereby to help categorize the existing ideas and concepts and furthermore identify the potential for future contributions to that field. Hence, according to Huff's (2009) systematic literature review approach, this paper uses a critical review approach.

Journal and conference publications are both highly accepted channels for communicating research findings to the IS research community. Therefore, major IS journals and conferences were chosen as primary sources for the review Webster and Watson (2002). The implemented research design is divided into two sequential phases: *literature selection* and *literature analysis*. The aim during the first phase - literature selection - was to identify relevant papers in major IS journals and conferences. During the second phase -

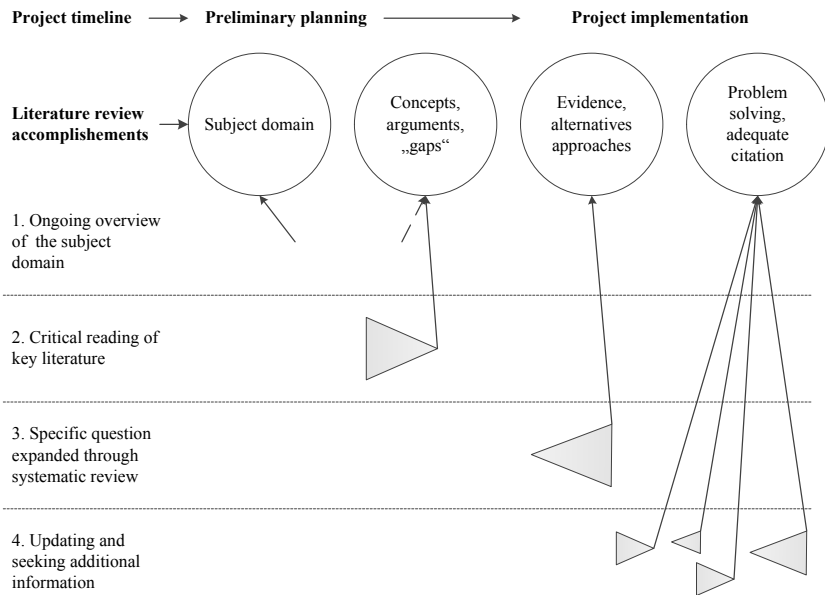


Figure 2.1: Types of literature review based on (Huff 2009)

literature analysis - an in-depth analysis of the selected papers was conducted. Figure 2.2 illustrates the research process.

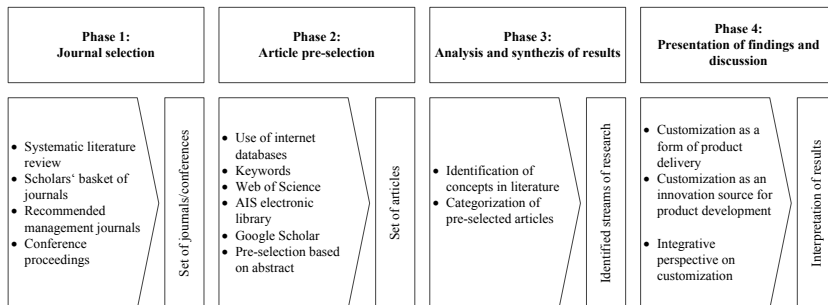


Figure 2.2: Phases of initial literature analysis

During the selection phase, the pool of journals and conference proceedings relevant to my study was first determined. With respect to journals, the research was concentrated on the senior scholars' basket of journals, which includes six journals (i.e., MIS Quarterly, Information Systems Research, Journal of Management Information Systems, Journal of the Association for Information Systems, European Journal of Information Systems, Information Systems Journal), as well as on general management journals as recommended by Fisher et al. (2007), Jourdan et al. (2008), and Mustafee (2011). With respect to conferences, the proceedings of the International Conference on Information Systems (ICIS) and the European Conference on Information Systems (ECIS) were included. Additionally, the proceedings of the Wirtschaftsinformatik conference was included because this conference (1) is the major German-speaking conference for IS research and (2) receives a higher share of design-oriented papers Österle et al. (2011), which was considered to be important given the aim of providing a coherent picture of customization.

As resources for potential articles, the ISI Web of Knowledge and the electronic library of the Association of Information Systems (AISel) were used for the review. In each database, titles and abstracts of the research articles

Table 2.2: Selected journals and number of articles in the initial review

#	Journal	Acronym	# Articles	# Preselect
1	MIS Quarterly	MISQ	8	4
2	Information Systems Research	ISR	7	3
3	Communication of the ACM	CACM	3	2
4	Journal of Management Information Systems	JMIS	5	5
5	Management Science	MS	16	15
6	Journal of the ACM	JACM	0	0
7	European Journal of Information Systems	EJIS	9	9
8	IEEE Transactions on Software Engineering	IEEEETSE	8	4
9	Information Management	I&M	4	1
10	Harvard Business Review	HBR	20	8
11	Wirtschaftsinformatik	WI	4	3
Total Journals			84	54

#	Proceedings	Acronym	# Articles	# Preselect
1	European Conference on Information Systems	ECIS	12	6
2	International Conference on Information Systems	ICIS	5	3
3	Wirtschaftsinformatik	WIP	6	2
Total Proceedings			23	11
Total			107	65

were searched using the phrases “customizing”, “customization”, “customising”, and “customisation”. While the search engine and interface in the case of the ISI Web of Knowledge was very user friendly, a little more manual effort was needed in the case of the AISel to restrict the search to the designated conferences. Finally, the research was limited such that only papers with a publication date after 2001 were considered. This resulted in a superset of 84 journal articles and 23 conference proceedings.

As a final step in the research selection phase, the abstracts of those 84 articles were analyzed to preselect relevant articles for further analysis. As a categorization code, a very simple A, B and C scheme was used, where A meant that the article fit our topics well (i.e., customization in IS and B2B), C meant that it did not fit at all and B meant that the article fell somewhere in between A and C. All articles within categories A and B were considered to be relevant for the research aim. Ultimately, a set of 54 journal papers and 11 conference papers was identified for the literature analysis. Table 1 summarizes the results of the selection phase.

After the pre-selection process, the in-depth analysis and synthesis of the identified articles was organized as follows. For each paper, the underlying research approach and definitions for customization concepts were identified. During the analysis, two streams of research in the field of software customization emerged: software customization as a form of product delivery and software customization as a form of co-creation. The following section presents those streams and discusses the associated papers.

## 2.4 The duality of software customization in IS research

### 2.4.1 Customization as a form of product delivery

As expected, customization appears to be a central topic in IS research. Predominantly, researchers focus on how software is delivered to customers in relation to distribution economics (Brocke et al. 2010; van Fenema et al. 2007; Weinmann et al. 2011). Packaged software, as one incarnation of product software, is presented as one way to address the challenges of customization in many articles within my review. For example, van Fenema et al. (2007) described packaged software as a “ready-made mass product offering users a solution based design process aimed at generic customer groups in a variety of industries and geographical areas.” A more general focus is delivered by Chiasson’s and Green’s (2007) definition of packaged software; they argue that an important question in packaged software design and consumption is determining what the software can and will do to support, change, and inhibit desired organizational practices.

In a similar vein, Sia and Soh (2007) describe the package-organizational fit as the central point of interest for package customization. Regarding uncertainty in customization projects, Safadi and Faraj (2010) describe workarounds as a valid way to address unanticipated requirements during the development or implementation of a software package. They define this post-implementation phenomenon as non-compliant user behavior vis-à-vis the intended system design. Although in extreme cases, formal systems are entirely bypassed, workarounds are widespread among organizations. From an architectural point of view, (Czarnecki et al. 2006) describe software product lines as a tool “to improve productivity, time-to-market, and quality of application development by leveraging the commonalities of systems within an application domain while managing their variations” to address some of the above-described challenges.

Table 2.3: Customization definitions and concepts

Author	Definition/Concept	Paper Type
<i>Customization as a form of distribution</i>		
Safadi and Faraj (2010)	Computer workarounds are a post-implementation phenomenon that is widespread in organizations. They are commonly defined as non-compliant user behaviors vis-à-vis the intended system design, and they may go so far as to bypass the formal systems entirely.	Case study
Brocke et al. (2010)	Although known primarily as a production principle [...], mass customization has also been applied to intangible products [...] with a focus on distributive and marketing aspects when mass customizing offerings and deals.	Conceptual paper
Chiasson and Green (2007)	One important question in packaged software design and consumption is determining what the software can and will do to support, change, and inhibit desired organizational practices.	Case study (Participation)
Dewan et al. (2003)	Improvement in manufacturing flexibility allows the mass customization of consumer products without significantly compromising cost efficiency. Not surprisingly, mass customization has begun to erode the domain of mass-produced standard items.	Game theory



Table 2.4: Customization definitions and concepts (continued)

Author	Definition/Concept	Paper Type
<i>Customization as a form of distribution</i>		
Keßler and Alpar (2008)	Both [OS and COTS software] need to be customized to fit the requirements of the adopting organization. Configuration and parameterization are the approaches of choice in this case. If they are not sufficient, customization of the SW code is necessary.	Action research
Swaminathan and Tayur (2003)	The internet has increased customers' expectations for complete customization at a nominal charge. Even before the advent of e-business, firms faced the challenge of mass customization and high product variety, but this has increased immensely over recent years.	Conceptual paper
van Fenema et al. (2007)	Packaged enterprise software is a ready-made mass product offering users a solution-based design process aimed at generic customer groups in a variety of industries and geographical areas. Packaged software can be contrasted with custom-built approaches based on the organization of the development and delivery processes.	Conceptual paper (Qualitative interviews)
Weinmann et al. (2011)	Product configuration systems are useful instruments for individualization in the field of mass customization.	Experiment

To date, a considerable stream of research has addressed the means of distribution (i.e., packaging) of product software and regards customization in an “after-production” sense. Because this perspective developed from a logic in which a product is first produced and then distributed, it corresponds with the inside-out perspective of customization in IS introduced earlier.

### **2.4.2 Customization as a form of co-creation of value**

Another stream of research in the IS literature addresses the development side of software as well as customer integration during the development processes in particular. For example, Piller et al. (2004) state that “within mass customization, customers are integrated into value creation by defining, configuring, designing, matching, or modifying their individual solution out of a list of options and pre-defined components”. In a similar vein, Xin and Levina (2008) argue that clients not only customize the software to their needs, but also change organizational practices to fit the software product.

Additionally, research has focused on the tailoring of software methods to development contexts. Fitzgerald et al. (2006) argue that factors such as organizational issues, distributed teams, and the existence of legacy systems require different or changed development methods. In a similar vein, Slaughter et al. (2006) describe strategy and process fit as being important for the development process. From their point of view, process customization or tailoring is important to fit the needs of specific organizations or projects. This involves adapting, particularizing, or selecting certain software processes.

## **2.5 The reciprocal nature of software customization**

While there is a common understanding of customization as the adaption of software products or more general IT artifacts to specific customer needs,

Table 2.5: Customization definitions and concepts (continued)

Author	Definition/Concept	Paper Type
<i>Customization as co-creation</i>		
Piller et al. (2004)	Within mass customization, customers are integrated into value creation by defining, configuring, designing, matching, or modifying their individual solution from a list of options and pre-defined components.	Conceptual paper
Xin and Levina (2008)	In such cases, clients can either change their organizational practices to fit the software or customize the software application and incur some cost to fit their needs.	Hypotheses development
Czarnecki et al. (2006)	The goal of SPLs is to improve productivity, time-to-market, and the quality of application development by leveraging the commonalities of systems within an application domain while managing their variations. SPLs package these commonalities in domain-specific platforms, which may be customized through configuration settings or code extensions.	Conceptual paper
Fitzgerald et al. (2006)	A related stream of research has focused on the tailoring of software methods to the actual needs of the development context. Factors such as organizational issues [...], distributed teams [...], or the existence of legacy systems [...] often require the use of a different method or at least changes to the existing method.	Interviews
Slaughter et al. (2006)	Process customization or tailoring involves adapting, particularizing, or selecting certain (often standard or ?best practice?) software processes to fit the needs of specific organizations or projects.	Case study (Qualitative interviews)

the existing IS literature primarily uses concepts of customization from other disciplines. For example, the term 'mass customization' has almost always been defined in relation to industrial contexts without providing a sufficient definition in relation to the characteristics of IS artifacts. Furthermore, the literature differs to a great extent in describing the level of customization because the term is used for the configuration, parameterization, adaption or development of existing or new source code.

For customer- and vendor-related reasons, the intensity of interaction in customization projects can be very high. For instance, because of a high level of innovation, neither the customer nor the vendor is able to pre-estimate the effort required to implement desired functionalities (Chiasson and Green 2007; van Fenema et al. 2007). In these cases, customization requires the customer's support to understand and change his processes (e.g., by means of consulting services). On the vendor side, the software product's "manufacturing flexibility" or architectural agility may not be sufficient to implement the desired functionality in a standardized way, and for example, the source code might need to be changed (Keßler and Alpar 2008). Thus, customization (in general) can be defined as a highly iterative form of IS implementation or adaption, where vendor and customer interactions are so intensive that it is not possible to handle them in single iterations of knowledge transfer.

*Customization is the process of configuring, parameterizing or, in general, adopting an IS artifact to a customer's need in more than one iteration. In this case, either the customer is NOT able to communicate his requirements in one step OR the vendor's manufacturing and distribution system is NOT capable of delivering the customized artifact in one additional step and a more intensive interaction between those two parties is necessary.*

In contrast, mass customization focuses on the efficiency aspect of customization. The term was initially introduced by Davis (1996) and later defined in the industrial engineering work of Tseng and Jiao (2001) as "producing goods and services to meet individual customer's needs with near

mass production efficiency”. Within IS, product configuration is an instrument for implementing mass customization (Weinmann et al. 2011). Due to the efficiency aspect of mass customization, the customer must have a sufficient understanding of his requirements, while the vendors’ delivery system must be flexible (and standardized) enough to integrate these requirements into the existing product. Thus, at least one iteration of knowledge transfer occurs: the customer provides his knowledge on the requirements to the vendor, and the vendor reacts by delivering a customized product. With respect to IS research and regarding the efficiency aspect, mass customization is defined as follows:

*Mass customization is the process of configuring, parameterizing or generally adapting an IS artifact to a customer’s needs in one iteration. This happens only if the customer is able to communicate his requirements in one step and if the vendor’s manufacturing and distribution system is capable of delivering the customized artifact in one additional step.*

The review revealed that current studies differentiate customization by means of level (customization and mass customization) and intention (co-creation of value and product distribution). Although existing literature considers these aspects to a certain extent, it lacks research studies that integrate the accumulated body of research. For instance, while the literature differentiates the level of customization between customization in general and mass customization approaches, further studies are needed that investigate the influence of the underlying customization technique on these levels. To date, the existing literature describes product configuration as a tool for implementing mass customization functionality. Considering my definitions of customization and mass customization based on interaction efficiency, mass customization might also be implemented using other techniques such as parameterization or source code development. Additionally, further research studies are needed investigating how customization intention influences software product management and vice versa. For instance, from a vendor per-

spective, co-creation of value projects might be valuable for orienting the software product. From this point of view, such projects can be considered a crucial investment in software product management. Here, future research should focus on identifying the drivers and barriers of those customization activities and on understanding how vendors value and balance the co-creation of value and product distribution projects.

Second, as already mentioned, customization strongly depends on interaction and knowledge transfer between vendors and customers. Considering customization as a service, a reciprocal knowledge exchange from vendor to customer (inside-out) and from customer to vendor (outside-in) can be assumed. In this area, further research is needed to investigate the influence of the customization level and intention on the characteristics and transfer of exchanged knowledge. Regarding the level of customization, I assume that due to interaction intensity with respect to tangible and intangible knowledge, customization (in general) is a richer medium of knowledge transfer than mass customization. However, within mass customization, the vendor's manufacturing system must be close to the customers' requirements to provide efficient customization functionality. In this case, I assume that the vendor already has a certain knowledge base about the topic of interest, which facilitates the exploration and assimilation of new knowledge. Here, I state that future research in the context of customization should place more emphasis on knowledge characteristics and on the knowledge exploration, assimilation and exploitation processes.

As expected, the IS literature has paid attention to both customization as a form for realizing economies of scale by using "make one, sell many"-approaches (inside-out) and as a way of integrating customers into the innovation process (outside-in). Surprisingly, the combination of both perspectives has been somewhat neglected by IS research. Regarding customization as understood in practice, that is, the customization of large business software in B2B contexts, the customer provides his knowledge in his area of expertise as well as his requirements in multiple iterations. Thus, the customer complements the vendor's knowledge at a technological and a market level not

only at a distinct point in time, as with mass customization, but also continuously. Because frequently receiving formulated requirements is demanding, vendors in a customization scenario must develop a particular type of absorptive capacity (Lichtenthaler 2009) to sufficiently benefit from external knowledge. However, as the review shows, reciprocal knowledge flows pertaining to customization and customizing are largely neglected within the IS literature.

In summary, from the observation, it can be posited that the existing literature is limited to regarding knowledge transfer between vendor and customer in multiple iterations, which drives us to delineate future research areas. To clarify these assumptions, Figure 2.3 shows the reciprocal “inside-out” and “outside-in” relationship between the vendor and the customer. For reasons of simplicity, intermediates such as consultants and professional services are left out and subsumed under the term ‘vendor’. Although the research results highlight the differences in the definition and application of customization concepts in the IS literature, further research in this area is needed, especially with regard to the interaction of software product management and software customization.

## 2.6 Summary

The objective of this section was to explore and summarize the existing concepts of software product customization. Although research has contributed to understanding (mass) customization, it has only begun to explore both fields in the context of the software business. In this section, I provided a systematic review of the concepts behind software product customization in the IS literature.

Recent research has contributed the field of software product management in three different fields. It has found definitions and provided several categorizations for software products. Furthermore, it has provided conceptual models for the strategic and operational perspective of software product

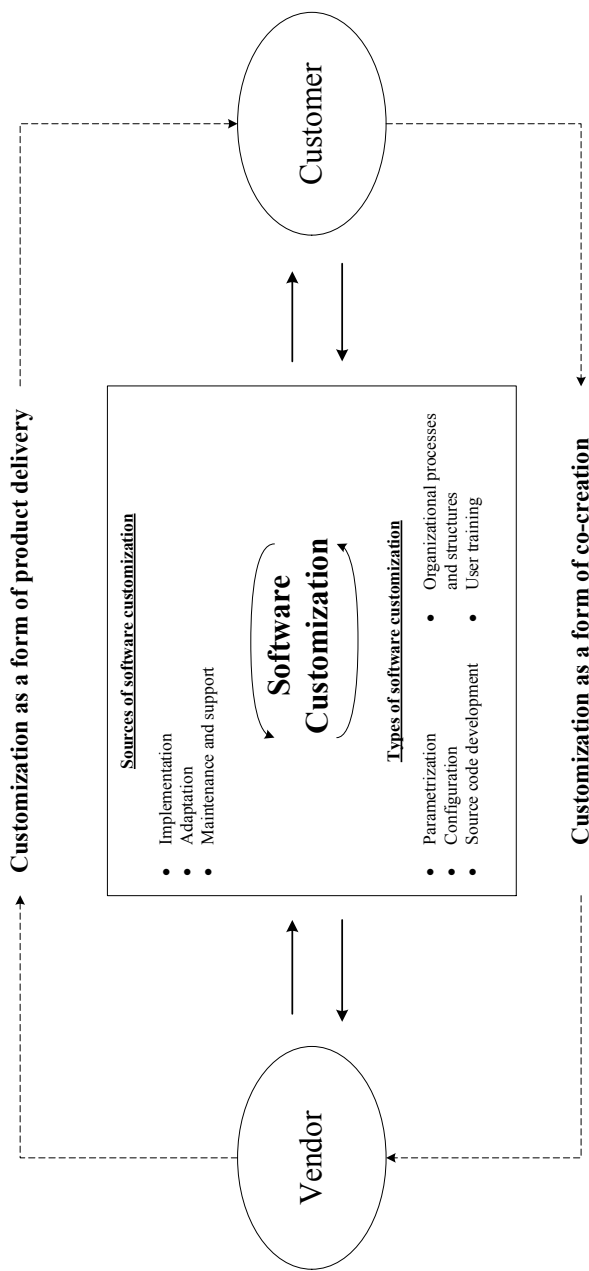


Figure 2.3: The concept of customization in the IS literature



management. However, to date, the distinction between software product management and classical or traditional software engineering is not clear. Many overlapping areas still must be analyzed and systematized. Software product lines might be a good option as a starting point for the integration of both streams of research.

In contrast to software product management, research on software customization still lacks integrated conceptual models. Existing research can be categorized in two different streams: customization as a form of product delivery and customization as a form of co-creating value. Finally, there is virtually no research on the reciprocal nature of software customization. Although existing research has covered customer integration and the knowledge transfer from vendors to customers during customization projects, it still lacks an integrated conceptualization of software customization. This supports the validity of the initial research question and the analysis of the interaction between product management and customization as a research objective for this thesis.

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